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A STUDY OF THE EFFECTS OF VARIOUS TEACHING METHODS ON ACHIEVEMENT IN COLLEGE ALGEBRA AND ANALYTIC GEOMETRY WITH SPECIAL INQUIRY INTO STUDENT PARTICIPATION

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The teaching of college mathematics has for many years been subjected to more than its share of adverse criticism. The literature indicates that it is berated more than any other subject on the college level and also more than its counterparts on the elementary and secondary levels.

One reason for the poor instruction in college mathematics may be in the lack of research in this area, research which could shed light on what constitutes effective mathematics instruction at the college level. This study was an attempt to begin filling this void in educational research.

The Problem - The problem of this study consisted of three parts.

1. To determine the effect of an emphasis on student participation as a teaching method on achievement in college algebra.

2. To determine the effect of student participation as a teaching method on achievement in analytic geometry.

3. To determine the extent to which students of elementry college mathematics can comprehend elements of analytic geometry from reading the text book.

A review of the related research indicated that a number of experiments have been conducted involving student participation as a method of teaching secondary school mathematics and as a mthod of teaching other subjects, such as science, on the college level. These studies generally agreed to the superiority of the student participation method.

Studies concerned with student participation as a method of teaching college mathematics were not found in the search of the literature.

Procedure - The Algebra Experiment. This experiment was conducted in order to find an answer to problem one. Twelve sections (320 students) of Mathematics 55 classes at the Pennsylvania State University were given alternate forms of the Cooperative Intermediate Algebra Examination Quadratics and Beyond, as preliminary and post tests to measure growth in achievement.

The Teaching methods in these classes were analyzed to determine the extent to which student participation was used as a method. This analysis was done through interview with the cooperating teachers and through the use of questionnaires with the subjects of the experiment. It was found that six sections devoted one half or more of each class period to student participation while the six other sections had only a minimum amount of student participation. The sections which made more use of student participation in the classroom were termed the experimental groups and those taught by the more conventional method

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the control groups. The difference in growth between experimental and control groups were analyzed by measuring the significance of a difference between mean gains to determine which method was superior.

The Analytic Geometry Experiments. To study problems two and three above two analytic geometry experiments were conducted involving a total of 312 students. Both experiments involved controlled methods of instruction. The control group for the analytic geometry experiments involved teaching without student participation in the classroom. That is, the instruction was to involve the student as a listener and watcher and not as a participant.

One experimental group was taught a two week unit on the ellipse and hyperbola using a minimum of one-half of each class period for student participation and a second experimental group was given no classroom instruction whatsoever on a one week unit, the hperbola. This second method represents 100% student participation although this participation was not supervised. The idea behind this second experiment was to determine if classroom time can occasionally be saved by assigning simple units or units similar to others which have been taught to be read outside of class with the expectation of reasonable student achievement.

Results in the two analytic geometry experiments were analyzed through the use of the Peters Regression Method, a method of mathematically equating groups. This method involves setting up a regression equation based on the statistics of the control group, then predicting by it what should be the achievement scores of the experimental group if the experimental factor produced no differential effect. Thus, the experimental methods were judged successful (or unsuccessful) to the extent that the average achievement of the experimetal groups surpassed (or fell short) of the average achievement predicted for them.

The following measures were the matching factors used in the regression technique:

1. Grade in previous college math course

2. Standing (in 5ths) in high school graduating class

3. Arithmetic section of the Moore-Castore Aptitude Examination

4. Algebra section of the Moore-Castore Aptitude Examination

Findings: Algebra Experiment

1. All sections, control and experimental, in the algebra experiment made gains in algebra achievement ranging from a mean gain of 2.7 scaled score points to 7 scaled score points.

2. The combined algebra experimental group surpassed the achievement of the combined control group to the extent that the difference was significant at the 1% level.

Analytic Geometry Experiments

1. The combined experimental group (minimum of one-half period of student participation) in the first analytic geometry experiment surpassed its predicted achievement but the difference was not significant.

2. The combined experimental group (no classroom instruction) in the second analytic geometry experiment surpassed its predicted achievement but the difference was not significant.

Conclusions:

1. The findings of the algebra experiment indicate that classroom emphasis on student participation may produce superior results.

2. The findings of the analytic geometry experiment are inconclusive as to the effects of student participation on achievement.

3. There is evidence from the findings of the analytic geometry experiment that achievement on short units is not hampered by assigning material to be read from the textbook without providing classroom instruction on the unit.

4. Discussion with the students and instructors showed both to lean in favor of the student participation method.

Interpretations and Implications

While the statistically significant results of this study are not preponderant several important implications follow:

The study has not guaranteed superior results for the student participation method of college mathematics instruction, but has clearly indicated that nothing is lost through its use. College instructors who have hesitated to use student participation as a method in fear of the fact that it is too time consuming may have some assurance of success with classroom participation. All experiments in this study were conducted under the usually rigorous time schedules followed by college mathematics course, and under these conditions the student participation method produced more than satisfactory results. It appears, then, that the college mathematics instructor is free to use student participation, not necessarily as a daily procedure, but at least as a means of introducing variety into the classroom.

The results of this study show that the teaching of college mathematics seems to parallel, with respect to student participation, the teaching of mathematics in the secondary schools and the teaching of science at the college level. Studies involving secondary mathematics and college science were reviewed showing their results to be similar to those of this experiment.

The analytic geometry experiment involving an experimental group receiving no classroom instruction on the hyperbola unit carries important implications for the teaching profession. A common feeling among instructors in elementary college mathematics courses is that if students learn anything from reading the

textbook without classroom explanation, too often that which is learned is false. This experiment indicates that his is no more true with respect to reading the textbook than in ordinary classroom learning. It should be made clear, however, that general applicability of this idea is not claimed. The unit covered, the hyperbola is very similar to the previous unit covered, the ellipse, which had been taught. Thus, there would be obvious carry over from that work. So the problem was to determine if time can be saved occasionally by skipping related material and assigning it to be read. The answer to this question the experiment shows, is yes, if the students are held responsible for the material in the form of tests.

Suggestions for Further Study

1. Conduct an experiment with emphasis on student participation as a method of instruction in other branches of mathematics and in other fields using relatively long units of work.

2. Conduct an experiment with emphasis on student participation as a method using a long unit of work, such as differential calculus, involving matched groups and making daily observations of classes, using a check list or journal to provide greater insight into method.

3. Conduct an experiment on student participation as a method with time checks on the actual period devoted to student participation possibly taking into account out of school participation as well.

4. Conduct an experiment on a relatively long unit of work to determine the effect of the testing procedure used (number of tests, surprise or announced tests,) on achievement.

5. Conduct an experiment to determine the effect on achievement of student participation of an enrichment nature such as the project technique or the use of applied mathematics for the motivation of certain units.